PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

United States Patent and Trademark Office
(Box PCT)
Crystal Plaza 2
Washington, DC 20231
ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 12 July 1999 (12.07.99)	
International application No. PCT/NO98/00298	**Applicant's or agent's file reference** 129210/JGS/KR
International filing date (day/month/year) 05 October 1998 (05.10.98)	**Priority date** (day/month/year) 10 November 1997 (10.11.97)
Applicant CORNELIUSSEN, Knut, Snorre, Bach	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

25 May 1999 (25.05.99)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer A. Karkachi
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

WO 99/25148
PCT/NO98/00298

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTICE INFORMING THE APPLICANT OF THE COMMUNICATION OF THE INTERNATIONAL APPLICATION TO THE DESIGNATED OFFICES

(PCT Rule 47.1(c), first sentence)

To:
OSLO PATENTKONTOR AS
Postboks 7007 M
N-0306 Oslo
NORVÈGE

Nr. 29 O.Nr.
Mottatt
01 JUNI 1999
Går til: S

Date of mailing (day/month/year) 20 May 1999 (20.05.99)	
Applicant's or agent's file reference 129210/JGS/KR	**IMPORTANT NOTICE**

International application No.	**International filing date** (day/month/year)	**Priority date** (day/month/year)
PCT/NO98/00298	05 October 1998 (05.10.98)	10 November 1997 (10.11.97)

Applicant
TELEFONAKTIEBOLAGET LM ERICSSON et al

1. Notice is hereby given that the International Bureau has communicated, as provided in Article 20, the international application to the following designated Offices on the date indicated above as the date of mailing of this Notice:
   AU,CN,EP,IL,JP,KP,KR,US

   In accordance with Rule 47.1(c), third sentence, those Offices will accept the present Notice as conclusive evidence that the communication of the international application has duly taken place on the date of mailing indicated above and no copy of the international application is required to be furnished by the applicant to the designated Office(s).

2. The following designated Offices have waived the requirement for such a communication at this time:
   AL,AM,AP,AT,AZ,BA,BB,BG,BR,BY,CA,CH,CU,CZ,DE,DK,EA,EE,ES,FI,GB,GD,GE,GH,GM,HR,HU,
   ID,IS,KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MD,MG,MK,MN,MW,MX,NO,NZ,OA,PL,PT,RO,RU,SD,SE,
   SG,SI,SK,SL,TJ,TM,TR,TT,UA,UG,UZ,VN,YU,ZW
   The communication will be made to those Offices only upon their request. Furthermore, those Offices do not require the applicant to furnish a copy of the international application (Rule 49.1(a-bis)).

3. Enclosed with this Notice is a copy of the international application as published by the International Bureau on
   20 May 1999 (20.05.99) under No. WO 99/25148

REMINDER REGARDING CHAPTER II (Article 31(2)(a) and Rule 54.2)

If the applicant wishes to postpone entry into the national phase until 30 months (or later in some Offices) from the priority date, **a demand for international preliminary examination** must be filed with the competent International Preliminary Examining Authority before the expiration of 19 months from the priority date.

It is the applicant's sole responsibility to monitor the 19-month time limit.

Note that only an applicant who is a national or resident of a PCT Contracting State which is bound by Chapter II has the right to file a demand for international preliminary examination.

REMINDER REGARDING ENTRY INTO THE NATIONAL PHASE (Article 22 or 39(1))

If the applicant wishes to proceed with the international application in the **national phase**, he must, within 20 months or 30 months, or later in some Offices, perform the acts referred to therein before each designated or elected Office.

For further important information on the time limits and acts to be performed for entering the national phase, see the Annex to Form PCT/IB/301 (Notification of Receipt of Record Copy) and Volume II of the PCT Applicant's Guide.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer
J. Zahra

Telephone No. (41-22) 338.83.38

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

INFORMATION CONCERNING ELECTED OFFICES NOTIFIED OF THEIR ELECTION

(PCT Rule 61.3)

To:

OSLO PATENTKONTOR AS
Postboks 7007 M
N-0306 Oslo
NORVEGE

Nr. 58 O.Nr.

Mottatt
19 JUL 1999

Går til.

Date of mailing (day/month/year) 12 July 1999 (12.07.99)	
Applicant's or agent's file reference 129210/JGS/KR	IMPORTANT INFORMATION

International application No.	International filing date (day/month/year)	Priority date (day/month/year)
PCT/NO98/00298	05 October 1998 (05.10.98)	10 November 1997 (10.11.97)

Applicant
TELEFONAKTIEBOLAGET LM ERICSSON et al

1. The applicant is hereby informed that the International Bureau has, according to Article 31(7), notified each of the following Offices of its election:

   AP :GH,GM,KE,LS,MW,SD,SZ,UG,ZW
   EP :AT,BE,CH,CY,DE,DK,ES,FI,FR,GB,GR,IE,IT,LU,MC,NL,PT,SE
   National :AU,BG,BR,CA,CN,CZ,DE,GB,IL,JP,KP,KR,MN,NO,NZ,PL,RO,RU,SE,SK,US

2. The following Offices have waived the requirement for the notification of their election; the notification will be sent to them by the International Bureau only upon their request:

   EA :AM,AZ,BY,KG,KZ,MD,RU,TJ,TM
   OA :BF,BJ,CF,CG,CI,CM,GA,GN,GW,ML,MR,NE,SN,TD,TG
   National :AL,AM,AT,AZ,BA,BB,BY,CH,CU,DK,EE,ES,FI,GD,GE,GH,GM,HR,HU,ID,IS,
   KE,KG,KZ,LC,LK,LR,LS,LT,LU,LV,MD,MG,MK,MW,MX,PT,SD,SG,SI,SL,TJ,TM,TR,TT,
   UA,UG,UZ,VN,YU,ZW

3. The applicant is reminded that he must enter the "national phase" **before the expiration of 30 months from the priority date** before each of the Offices listed above. This must be done by paying the national fee(s) and furnishing , if prescribed, a translation of the international application (Article 39(1)(a)), as well as, where applicable, by furnishing a translation of any annexes of the international preliminary examination report (Article 36(3)(b) and Rule 74.1).

   Some offices have fixed time limits expiring later than the above-mentioned time limit. For detailed information about the applicable time limits and the acts to be performed upon entry into the national phase before a particular Office, see Volume II of the PCT Applicant's Guide.

   The entry into the European regional phase is postponed **until 31 months from the priority date** for all States designated for the purposes of obtaining a European patent.

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer:
A. Karkachi

Telephone No. (41-22) 338.83.38

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PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 129210/JGS/KR	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/NO98/00298	International filing date *(day/month/year)* 05.10.1998	Priority date *(day/month/year)* 10.11.1997
International Patent Classification (IPC) or national classification and IPC7 H 04 L 12/56, H 04 Q 11/04		
Applicant Telefonaktiebolaget LM Ericsson et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of _____ sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
25.05.1999	02.02.2000
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Telex 17978 PATOREG-S Facsimile No. 08-667 72 88	Authorized officer Stig Edhborg/MN Telephone No. 08-782 25 00

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/NO98/00298

I. Basis of the report

1. This report has been drawn on the basis of *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.)*:

☒ the international application as originally filed.

☐ the description, pages _____ , as originally filed,
pages _____ , filed with the demand,
pages _____ , filed with the letter of _____ ,
pages _____ , filed with the letter of _____ .

☐ the claims, Nos. _____ , as originally filed,
Nos. _____ , as amended under Article 19,
Nos. _____ , filed with the demand,
Nos. _____ , filed with the letter of _____ ,
Nos. _____ , filed with the letter of _____ .

☐ the drawings, ~~sheets~~/fig _____ , as originally filed,
~~sheets~~/fig _____ , filed with the demand
~~sheets~~/fig _____ , filed with the letter of _____ ,
~~sheets~~/fig _____ , filed with the letter of _____ .

2. The amendments have resulted in the cancellation of:

☐ the description, pages _____
☐ the claims, Nos. _____
☐ the drawings, ~~sheets~~/fig _____

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the supplemental Box (Rule 70.2(c)).

4. Additional observations, if necessary:

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/NO98/00298

V. Resoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	1-17	YES
	Claims		NO
Inventive step (IS)	Claims	1-17	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-17	YES
	Claims		NO

2. Citations and explanations

The claimed invention relates to a method for controlling the traffic in an ATM network so as to maintain the Quality-of-Service (QoS) thereof by implementing Usage Parameter Control, comprising at least one leaky bucket unit. The leaky bucket unit is arranged between an original cell flow of ATM-cells and a switch unit. There has been used one counter for each bucket per connection. The counters are increased or decreased according to predetermined criteria by means of timer counter means.

The purpose of the invention is to provide a method wherein the dual leaky bucket principle can be implemented in a more efficient manner and also provide a method wherein decrease of bucket counters can be effected as a simple and fast process. The idea is to decrease the bucket counters at regular intervals but only when there is no arriving cells and, furthermore, computing real bucket values for a connection when a cell for said connection arrives.

The following documents are cited in the International Search Report:
D1: US 5402426 A
D2: US 5530695 A
D3: David E. McDysan et al, "ATM Theory and application", 1995, McGraw-Hill inc., USA, page 347 - page 364

D1 discloses a method and circuit arrangement for checking the observance of prescribed transmission bit rates of the individual virtual connections for asynchronous transmission of message cells of fixed length during the course of virtual connections in switching equipment.

.../...

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: V

D2 describes an asynchronous transfer mode (ATM) traffic control framework based on an integrated usage parameter control (UPC) approach, which approach provides a unified and scaleable solution to the issue of Quality-of-Service (QoS) levels over a range of anticipated services in ATM based networks.

D3 explains the formal concept of traffic contract from ITU-T recommendation I.371 and the ATM Forum UNI specification version 3.0 in an application-oriented manner. D3 is attached only to explain the idea of using leaky buckets and to display some parameters defined in this area.

However, neither D1 nor D2 describe the method of decrease the bucket counters at regular intervals but only when there is no arriving cell. Accordingly D1-D3 are considered to describe the general state of the art. Therefore, the invention as claimed in claims 1-17 is novel (N), is considered to involve an inventive step (IS) and to have industrial applicability (IA).

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 98/00298

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04L 12/56, H04Q 11/04
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04L, H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5402426 A (ANDREAS FOGLAR ET AL), 28 March 1995 (28.03.95), column 2, line 42 - line 44; column 4, line 2 - line 18; column 11, line 1 - line 11	1-17
A	US 5530695 A (RAJIV DIGHE ET AL), 25 June 1996 (25.06.96)	1-17
A	David E. McDysan et al, "ATM Theory and application", 1995, McGraw-Hill inc., USA, page 347 - page 364	1-17

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 May 1999	17-05-1999
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM	Authorized officer Göran Magnusson

INTERNATIONAL SEARCH REPORT

Information on patent family members

07/04/99

International application No.
PCT/NO 98/00298

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5402426 A	28/03/95	CA 2094561 A	24/10/93
		EP 0566961 A,B	27/10/93
US 5530695 A	25/06/96	CA 2118471 A	16/06/95
		EP 0658999 A	21/06/95
		JP 7170274 A	04/07/95

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NO 98/00298

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04L 12/56, H04Q 11/04
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04L, H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5402426 A (ANDREAS FOGLAR ET AL), 28 March 1995 (28.03.95), column 2, line 42 - line 44; column 4, line 2 - line 18; column 11, line 1 - line 11	1-17
A	US 5530695 A (RAJIV DIGHE ET AL), 25 June 1996 (25.06.96)	1-17
A	David E. McDysan et al, "ATM Theory and application", 1995, McGraw-Hill inc., USA, page 347 - page 364	1-17

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 May 1999	17-05-1999
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Göran Magnusson Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

Information on patent family members

07/04/99

International application No.
PCT/NO 98/00298

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5402426 A	28/03/95	CA 2094561 A	24/10/93
		EP 0566961 A,B	27/10/93
US 5530695 A	25/06/96	CA 2118471 A	16/06/95
		EP 0658999 A	21/06/95
		JP 7170274 A	04/07/95

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : H04L 12/56, H04Q 11/04	A3	(11) International Publication Number: WO 99/25148
		(43) International Publication Date: 20 May 1999 (20.05.99)

(21) International Application Number: PCT/NO98/00298

(22) International Filing Date: 5 October 1998 (05.10.98)

(30) Priority Data:
19975152 10 November 1997 (10.11.97) NO

(71) Applicant *(for all designated States except US)*: TELEFONAKTIEBOLAGET LM ERICSSON [SE/SE]; S-126 25 Stockholm (SE).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: CORNELIUSSEN, Knut, Snorre, Bach [NO/NO]; Hegdehaugsveien 35, N-0352 Oslo (NO).

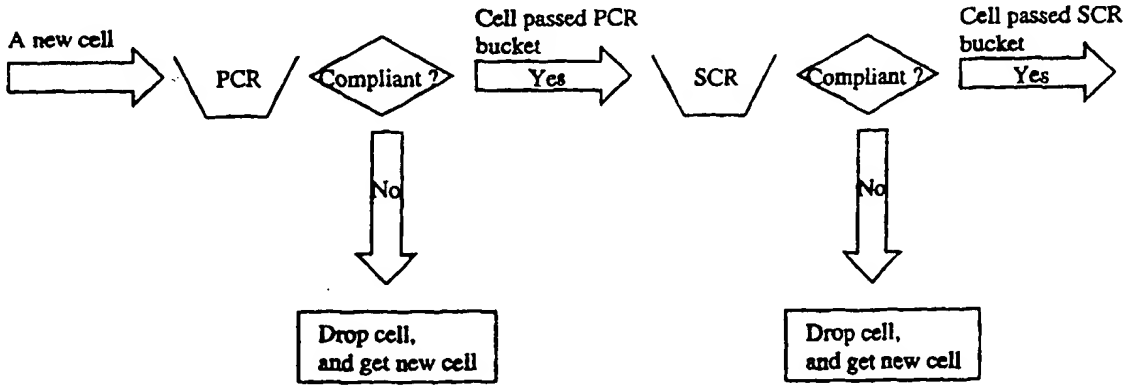
(74) Agent: OSLO PATENTKONTOR AS; Postboks 7007 M, N-0306 Oslo (NO).

(81) Designated States: AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(88) Date of publication of the international search report:
15 July 1999 (15.07.99)

(54) Title: METHOD FOR CONTROLLING THE TRAFFIC IN AN ATM NETWORK SO AS TO MAINTAIN THE QUALITY OF SERVICE



(57) Abstract

The present invention relates to a method for controlling the traffic in an ATM (Asynchronous Transfer Mode) network so as to maintain the Quality of Service (QoS) thereof by implementing Usage Parameter Control (UPC) comprising at least one leaky bucket unit arranged between an original cell flow of ATM-cells and a switch unit, there being used one counter for each bucket per connection, said counters being incremented and decremented according to predetermined criteria by means of timer counter means, and for the objective of providing a method which can be implemented in a far more time consuming and hardware requiring implementation it is according to the invention suggested a method characterized by the combination of the following steps: decrementing the bucket counters at regular intervals but only when there are no arriving cells, and computing real bucket values for a connection when a cell for said connection arrives.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

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PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : H04Q 11/04

A2

(11) International Publication Number: **WO 99/25148**

(43) International Publication Date: 20 May 1999 (20.05.99)

(21) International Application Number: PCT/NO98/00298

(22) International Filing Date: 5 October 1998 (05.10.98)

(30) Priority Data:
19975152 10 November 1997 (10.11.97) NO

(71) Applicant *(for all designated States except US)*: TELEFONAKTIEBOLAGET LM ERICSSON [SE/SE]; S–126 25 Stockholm (SE).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: CORNELIUSSEN, Knut, Snorre, Bach [NO/NO]; Hegdehaugsveien 35, N–0352 Oslo (NO).

(74) Agent: OSLO PATENTKONTOR AS; Postboks 7007 M, N–0306 Oslo (NO).

(81) Designated States: AL, AM, AT, AT (Utility model), AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, EE (Utility model), ES, FI, FI (Utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (Utility model), SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
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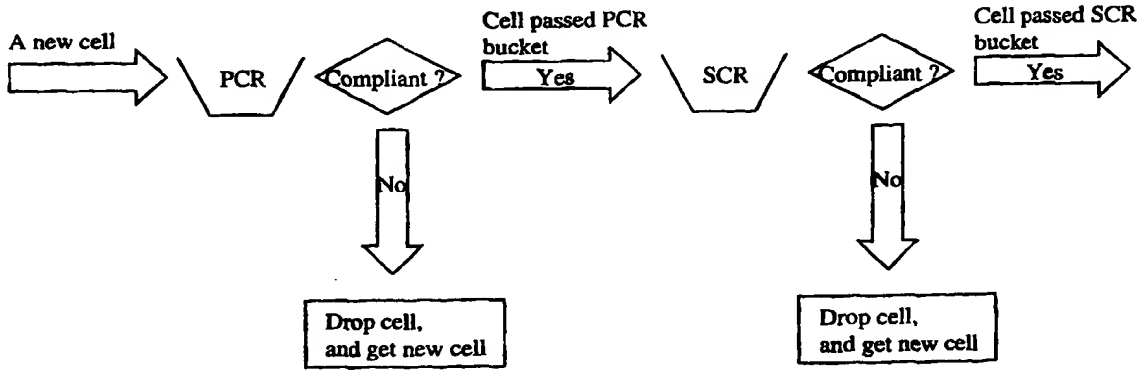
(54) Title: METHOD FOR CONTROLLING THE TRAFFIC IN AN ATM NETWORK SO AS TO MAINTAIN THE QUALITY OF SERVICE



(57) Abstract

The present invention relates to a method for controlling the traffic in an ATM (Asynchronous Transfer Mode) network so as to maintain the Quality of Service (QoS) thereof by implementing Usage Parameter Control (UPC) comprising at least one leaky bucket unit arranged between an original cell flow of ATM–cells and a switch unit, there being used one counter for each bucket per connection, said counters being incremented and decremented according to predetermined criteria by means of timer counter means, and for the objective of providing a method which can be implemented in a far more time consuming and hardware requiring implementation it is according to the invention suggested a method characterized by the combination of the following steps: decrementing the bucket counters at regular intervals but only when there are no arriving cells, and computing real bucket values for a connection when a cell for said connection arrives.

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METHOD FOR CONTROLLING THE TRAFFIC IN AN ATM NETWORK SO AS TO MAINTAIN THE QUALITY OF SERVICE

Field of the invention

The present invention relates to a method for controlling the traffic in an ATM (Asynchronous Transfer Mode) network so as to maintain the Quality of Service (QoS) thereof by implementing Usage Parameter Control (UPC) comprising at least one leaky bucket unit arranged between an original cell flow of ATM-cells and a switch unit, there being used one counter for each bucket per connection, said counters being incremented and decremented according to predetermine criteria by means of timer counter means.

It is to be understood that the present invention finds particular application in connection with billing and policing in ATM based networks.

Technical background

THE PROBLEM

A widely used method for allocating resources in an ATM network is to base the allocation on the PCR (Peak Cell Rate) and the SCR (Sustainable Cell Rate). The values for PCR and SCR are provided by the user of the ATM network during the connection establishment. The values given for PCR and SCR are part of the traffic contract for the given connection. To maintain the QoS on the user's and all the other ATM connections in the network, it is important that the traffic from the users does not exceed their PCR and SCR. The action taken to ensure that the traffic from the users is conform with the traffic contract is called the Usage Parameter Control (UPC). A method for implementing UPC is with a leaky bucket. The

idea behind a leaky bucket is shown in ATM Forum's "User-Network Interface Specification" [1]. For Constant Bit Rate (CBR) traffic the UPC can consist of a single leaky bucket.

Figure 1 illustrates a single Leaky Bucket arrangement. The bucket is filled according to the bit rate of the traffic sent by the user. It is emptied at fixed time intervals. The size of the bucket is dependent on i.e. the PCR and CDV (Cell Delay Variation).

The leaky bucket is used to check if the user's traffic is compliant to its PCR, including the possibility of cell delay variation within an agreed bound. For Variable Bit Rate (VBR) it is proposed that the UPC consists of a dual leaky bucket. The task for the dual leaky bucket is to check that the traffic sent by the user is conform to the combination of PCR, CDV and SCR, BT (Burst Tolerance (BT) is the maximum burst size that can be sent at the SCR).

A dual leaky bucket is implemented with two buckets, one for checking PCR and CDV, and one for SCR and BT. When overflow occurs in one of the buckets, the traffic from the user is considered non conforming to the traffic contract. According to the specific network implementation the appropriate action is taken.

Figure 2 illustrates an arrangement wherein the leaky bucket (single or dual) is placed in front of the switching unit.

The problem with both the single and the dual leaky bucket is to implement them in real time systems. When the number of connections is large and a high bandwidth is used, there may be difficulties in having time to

perform the various calculations (i.e. compute new bucket values). This is especially a problem when implementing a dual leaky bucket, which requires even more computations.

Known solutions

One method for implementing a dual leaky bucket is to have two buckets in parallel. There is one counter for each bucket per connection. These bucket counters are incremented every time a cell for that connections arrives, and it is checked whether the bucket counters are larger than some predefined threshold values. If one of the counter values is above its threshold, the cell is either tagged, or thrown. At regular time intervals, each bucket counter for all the connections is decremented according to a decrement value specific for each channel and bucket.

Another method for implementing a dual leaky bucket is to have two bucket counters for each connection. This method uses the same mechanism for incrementing the buckets as described above. The difference is that with this method the bucket counters for connections are not decremented at regular time intervals, only when a cell for that connection is received. To obtain a true value in each of the buckets, a time counter is used for each connection. The time counters holds the last time the bucket counters for their connection were updated.

Problems with known solutions

The problem with the first method is that the process of decrementing all the bucket counters at regular time intervals is time consuming. When the number of connections is large, high bandwidth is supported, and the time

between each decrement is small, it may be impossible to have time for all these calculations.

In the second method the number of calculations is largely decreased. One problem by using this method is that you need an extra counter for each connection (the time counter). This can be a problem when the number of supported connection is high. The biggest problem with this method is the size of the time counter. When high bandwidths are supported the time counters have to be very accurate. The problem arises when a connection with much lower bandwidth than the maximum allowed bandwidth is policed. Because of the low bandwidth, cells for these connections arrive at a much higher interval than cells belonging to connections of much higher bandwidth. If the time counter is not large enough, overflow in the time counter can occur. This can lead to that cells that are conform with the traffic contract are discarded because an overflow in the time counter has occurred.

US 5 524 006 (Hluchyj et al.) relates to a second-order leaky bucket device and method for traffic management in cell relay networks, wherein the second-order leaky bucket system is utilized in connection with a peak cell rate (PCR) leaky bucket, for thereby substantially providing a predetermind quality of service.

EP-0 658 999-A2 (Dighe/NEC corporation) relates to an ATM network wherein the data frames of the system are controlled by use of "Dual Leaky Bucket" principle.

US 5 295 135 (Kammerl) relates to an arrangement for monitoring the bit rate in ATM networks, wherein the bit rate is monitored and controlled by means of "Dual Leaky Bucket" principle.

US 5 289 462 (Ahmadi et al.) relates to traffic management in packet communications networks, wherein the parameters of a "leaky bucket" are calculated by using a traffic metric system.

Objects of the invention

An object of the present invention is to provide a method wherein the dual leaky bucket principle can be implemented in a more efficient manner.

Another object of the present invention is to provide a method wherein decrementing of bucket counters can be effected as a simple and fast process.

Yet another object of the present invention is to provide a method wherein the priority of the buckets involved are utilised in a far more expedient manner.

Still another object of the present invention is to provide a method wherein the amount of needed computations are reduced substantially.

Yet another object of the present invention is to provide a method requiring less storage capacity and only one single time counter for all connections.

Still another object of the invention is to provide a method in which the decrement factor can be chosen in a more versatile manner so as to obtain better granularity of the system involved.

Brief summary of the invention

The above objects are achieved in a method as claimed in the preamble, which according to the present invention is charachterized by the combination of the following steps:
- decrementing the bucket counters at regular intervals but only when there are no arriving cells, and
- computing real bucket values for a connection when a cell for said connection arrives.

More specifically, said combination of steps are used in connection with two buckets which are arranged in the same process but given different priority, said two buckets preferably being arranged in series.

Consequently, by placing the two buckets into the same process the amount of needed computations will be lowered.

Further, according to the present invention there is used only a single time counter for all connections involved, rendering the system even more favourable as regards computation time and accuracy.

Still further, by giving the different buckets different priority, still more time will be available for decrementing said buckets since the wasting of cells at a first bucket will allow more time for the system for decrementing the buckets involved.

Further features and advantages of the present invention will appear from the following description taken in connection with the appended drawings, as well as from the enclosed patent claims.

Brief disclosure of the drawings

Fig. 1 is a simplified diagram illustrating the principle of a single leaky bucket arrangement, the bucket here being filled according to the bit rate of the traffic sent by the user.

Fig. 2 is a schematical diagram illustrating an arrangement of a prior art leaky bucket principle, it being single or dual, and being placed in the front of an associated switching unit.

Fig. 3 is a schematical diagram illustrating a prior art implementation of a dual leak bucket arrangement.

Fig. 4 is a schematical diagram illustrating an embodiment of a method according to the present invention, wherein the dual bucket principle has been implemented in the process for lowering the amount of needed computations.

Fig. 5 is a schematical block diagram illustrating an embodiment for implementing the invention, said figure comprising the main elements included in a dual leaky bucket unit substantially as illustrated in Fig. 2.

Fig. 6 is a flow sheet illustrating the various steps taken according to the present method in order to increment for example SCR and PCR buckets.

Fig. 7 is a flow diagram illustrating the steps involved according to the present method in order to decrement a PCR and SCR bucket involved therein.

Detailed description of embodiments

It is to be understood that the present method as been developed in connection with principally a dual leaky bucket arrangement, but it is to be understood that the principle of the present invention can also be applicable to any number of buckets operating in accordance therewith.

As mentioned previously, Fig. 1 illustrates a single leaky bucket arrangement according to the prior art. The bucket is filled according to the bit rate of the traffic sent by the user, and it is, according to prior art, emptied at fixed time intervals. The size of the bucket is dependent on i.e. the Peak Cell Rate (PCR) and the Cell Delay Variation (CDV).

In Fig. 2 there is illustrated a leaky bucket arrangement including single or dual buckets, said buckets being placed in front of the associated switching unit.

In Fig. 3 there is illustrated an example of how a prior art arrangement can be implemented, i.e. how a new cell is arrived firstly at the PCR Peak Cell Rate bucket for being checked whether compliant with the filling degree thereof, and thereafter the same new cell is controlled by the SCR Sustainable Cell Rate bucket for being checked to be compliant with also the filling degree thereof, whereafter any non-compliant signal from both buckets are sent to a decision circuit for making the decision to drop a cell and allow for a new cell to be controlled, or for the passing of said double controlled cell to be transmitted via said switching unit.

The arrangement according to Fig. 3 illustrates two buckets in parallel requiring one counter for each bucket

per connection, and the associated bucket counters are incremented every time a cell for that connection arrives, and it is also checked whether the bucket counters are larger than some predefined threshold values.

According to this prior art arrangement each bucket counter for all the connections is decremented according to a decrement value specific for each channel and bucket.

As mentioned previously, another prior art method for implementing such a dual leaky bucket is to have two bucket counters for each connection, but with this method the bucket counters for connections are not decremented at regular time intervals, only when a cell for that connection is received. To obtain a true value in each of the buckets a time counter must be used for each connection, said time counters holding the last time the bucket counters for the associated connection were updated.

Now, turning to Fig. 4, there is illustrated an embodiment of a method according to the present invention which involves a series of advantages compared with the above described prior art.

In other words, the present invention is a solution for implementing a dual leaky bucket efficiently. This invention follows some of the principles from [2], but it extends this method to support not only one, but two leaky buckets (called a dual leaky bucket). The idea is:

- Decrement the bucket counters at regular intervals (but only when there are no arriving cells).

- Compute real bucket values for a connection, when a cell for that specific connection arrives.

- Place the two buckets into the same process to lower the amount of needed computations.

- When using two or more buckets the buckets are arranged in series according to priority.

With reference to the enclosed Figures 4-7 and the enclosed appendix A there will be now given a detailed description of an example of an embodiment according to the present invention.

Firstly, reference is made to Fig. 4 illustrating a simplified basic diagram of an embodiment according to the present invention, whereas Fig. 5 illustrates schematically an embodiment of a dual leaky bucket unit, substantially as illustrated in Fig. 2, but rearranged according to the method of the invention.

The parameters used in the following figures.

- M - The maximum number of different connections.
- m - Time counter, incremented each cell interval modulo M.
- n - The connection number.
- D - Decrement factor. This is the same for all the buckets and connections. The chosen value for D gives you the granularity of the system.

I^{PCR}_n - Increment factor of the PCR bucket for connection n.
I^{PCR}_n = bandwidth * (D/PCR).

F^{PCR}_n - The real value of the PCR bucket for connection n. F^{PCR}_n is calculated every time a cell belonging to connection n is received.

L^{PCR}_n - The virtual value of the PCR bucket for connection n. L^{PCR}_n is incremented by I^{PCR}_n when a cell for connection n is accepted. It is decremented by D*M every M'th cell.

T^{PCR}_n - The threshold value of the PCR bucket for connection n .
T^{PCR}_n = requested bandwidth * CDV

I^{SCR}_n - Increment factor of the SCR bucket for connection n.
I^{SCR}_n = bandwidth * (D/SCR).

F^{SCR}_n - The real value of the PCR bucket for connection n. F^{SCR}_n is calculated every time a cell belonging to connection n is received.

L^{SCR}_n - The virtual value of the PCR bucket for connection n. L^{SCR}_n is incremented by I^{SCR}_n when a cell for connection n is accepted. It is decremented by D*M every M'th cell.

T^{SCR}_n - The threshold value of the PCR bucket for connection n.
T^{SCR}_n = requested bandwidth * BT.

Description of Figures 4 and 5

Firstly, a cell is read from the Buffer-IN to the One cell buffer (marked ❶ in figure 5). The One cell buffer gets the VPI and VCI from the cell, and finds its connection number in the connection table. The One cell buffer then inserts the right connection number in n (marked ❷ in figure 5). The Logical Dual Leaky bucket Unit then reads the connection number from n. Then it reads the

counter values related to connection n from the Counter Table (marked ❸ in figure 5). The Logical Dual Leaky Bucket Unit then calculates if the cell is compliant with the traffic contract (marked ❹ in figure 5). When the calculation is finished, the Logical Dual Leaky Bucket Unit sends the new computed counter values to Counter Table (marked ❺ in figure 5). If the cell is compliant, the Logical Dual Leaky Bucket sends a Send Cell signal to the One cell buffer (marked ❻ in figure 5). If the cell is not compliant, the Logical Dual Leaky Bucket sends a Not Send Cell signal to the One cell buffer. If the One cell buffer received a Send Cell signal from the Logical Dual Leaky Bucket, it passes the cell to the Buffer-OUT (marked ❼ in figure 5). It then reads a new cell from the Buffer-IN. If the One cell buffer received a Not Send Cell signal from the Logical Dual Leaky Bucket Unit, it reads a new cell from the Buffer-IN that overwrites the old cell.

In the enclosed Figures 6 and 7, the algorithm used to compute whether a cell is compliant to the traffic contract or not is shown. This algorithm is placed inside the Logical Dual Leaky Bucket Unit in Figure 4.

The new steps (those exceeding [2]) for supporting a dual leaky bucket will be shown in bold.

It is to be understood that Fig. 6 illustrates the steps necessary to be taken according to the invention in order to increment the SCR and PCR buckets involved in the present embodiment.

Fig. 7 illustrates the steps necessary to be taken in the illustrated embodiment in order to decrement the associated PCR and SCR bucket.

Figure 6 shows in a flow diagram the method for incrementing the PCR and SCR bucket. After a specific time interval the process checks if a cell is waiting to be processed. If there is no cell waiting, the process goes to the decrement bucket state (see figure 7). If a new cell has arrived, the real value for the PCR bucket is calculated. This value is placed in F^{PCR}. The process then checks whether the real value (located in F^{PCR}) is greater than the maximum allowed PCR bucket value, T^{PCR}. If the real PCR bucket value is greater than the threshold value, a Not Send Cell signal is sent to the One cell buffer (see figure 6). The process then goes to state Decrement bucket (see figure 7). If the real PCR bucket value is equal or lower than the threshold value, the virtual value of the PCR bucket, L^{PCR} , is incremented by I^{PCR}. After the process has incremented the virtual value of the PCR bucket, it calculates the real value of the SCR bucket. This value is placed in F^{SCR}. It then checks whether F^{SCR} is greater than T^{SCR}. If the real value is greater than the threshold value, a Not Send Cell signal is sent to the One Cell buffer (see figure 5). If the real value of the SCR bucket is equal or lower than its threshold value, the virtual value of the SCR bucket, L^{SCR}, is calculated. A Send Cell signal is sent to the One cell buffer (see figure 5), and the process goes to the Decrement bucket state (see figure 7).

In Figure 7 the method for decrementing the buckets is shown. The first thing the process does is to increment the time counter m. The process then calculates the virtual value of the PCR and SCR bucket for connection number m. After this calculation the process goes to the Idle state.

A pseudo code example of an implementation of the method is shown in the enclosed Appendix A. This code is written

with emphasis on clarity. It is possible to run the calculation of a single bucket twice to decrease the program size

ADVANTAGES

With this invention, the number of computations is decreased, because not all buckets are decreased at regular time intervals. This method also resolves the time counter size problem, because buckets counters are decreased even though no cell has arrived on their connection. This method also requires less storage capacity because it only uses a single time counter for all the connections. This method for implementing a dual leaky bucket combines the two buckets in one process, it therefor lowers the amount of computations and overhead even more.

BROADENING

This method for implementing a dual leaky bucket can also be used as a single leaky bucket. You only have to set the increment value of the second bucket to zero.

REFERENCES

ATM Forum "User-Network Interface (UNI) Specification ver. 3.1." af-unit-0010.002, 09/94.

U.S: Pat.No. 5 361 252 Sällberg and Larsson "Method and device for monitoring channel split data packet transmission"

APPENDIX A

Pseudo code for the efficient dual leaky bucket implementation.

```
Begin
  Repeat
    Wait(t)
      If (New cell)
    Begin
PCR: If (m >= n) Then
        FPCRn := LPCRn - D * (m - n)
       Else
        FPCRn := LPCRn - D * (M + m -n)
       If  (FPCRn >= 0) Then
         If ((TPCRn - FPCRn) >= 0) Then
           Begin
       LPCRn := LPCRn + IPCRn                    /*Cell conforming
to                                                Traffic contract*/
       End
      Else

                                                /*Cell not conforming
                                                 to traffic contract*/

        Else
         Begin
            If (m >= n) Then
      LPCRn := IPCRn + D * (m - n)
            Else
      LPCRn := IPCRn + D * (M + m - n)  /*Cell conforming to
                                                 Traffic contract*/
         End
        End
SCR: If (m >= n) Then
       FSCRn := LSCRn - D * (m - n)
      Else
       FSCRn := LSCRn - D * (M + m -n)
      If  (FSCRn >= 0) Then
        If ((TSCRn - FSCRn) >= 0) Then
         Begin
      LSCRn := LSCRn + ISCRn              /*Cell conforming to
                                          Traffic contract*/
       End
      Else
       Goto DEC                           /*Cell not conforming to
                                          traffic contract*/
        Else
          Begin
            If (m >= n) Then
      LSCRn := ISCRn + D * (m - n)
            Else
       LSCRn := ISCRn + D * (M + m - n) /*Cell conforming to
                                            Traffic contract*/

          End
```

```
DEC: Begin
      m := (m + 1) MOD M
      LPCRm := LPCRm - M * D
      If (LPCRm < 0) Then
       LPCR := 0
       LSCRm := LSCRm - M * D
       If (LSCRm < 0) Then
        LSCR := 0
        End
Forever
End
```

Patent claims

1. Method for controlling the traffic in an ATM (Asyncrounous Transfer Mode) network so as to maintain the Quality of Service (QoS) thereof by implementing Usage Parameter Control (UPC) comprising at least one leaky bucket unit arranged between an original cell flow of ATM-cells and a switch unit, there being used one counter for each bucket per connection, said counters being incremented and decremented according to predetermined criteria by means of timer counter means, characterized by the combination of the following steps:
- decrementing the bucket counters at regular intervals but only when there are no arriving cells, and
- computing real bucket values for a connection when a cell for said connection arrives.

2. Method as claimed in claim 1, characterized in that said combination of steps are used in connection with two buckets which are arranged in the same process but given different priority, said two buckets preferably being arranged in series.

3. Method as claimed in claim 1 or 2, characterized in that there is used a PCR (Peak Cell Rate) bucket as a first bucket and a SCR (Sustainable Cell Rate) bucket as a second bucket, preferably connected in series with said first bucket.

4. Method as claimed in any of the claims 1-3, characterized in that there is used a dual leaky bucket arrangement comprising an LDLBU (Logical Dual Leaky Bucket Unit) which is adapted for calculating whether an arriving ATM-cell is compliant with

the traffic contract, and which performs said calculation after having read the connection number (n) of the ATM-cell in question (cell I+0) and thereafter the counter values related to that connection (n) from a CT (Counter Table).

5. Method as claimed in claim 4, c h a r a c t e r i z e d i n that when said calculation is finished the LDLBU will send the new computed counter values to said CT, and depending on whether the ATM-cell is compliant or not will send a Send Cell signal or Not Send Cell Signal, respectively, to a One Cell buffer being part of said dual leaky bucket arrangement.

6. Method as claimed in claim 5, c h a r a c t e r i z e d i n that if the One Cell buffer receives a Send Cell signal from said logical dual leaky bucket it will pass the cell to a buffer-out unit, whereafter a new cell from a buffer-in unit can be read.

7. Method as claimed in claim 5, c h a r a c t e r i z e d i n that if the One Cell buffer receives a Not Send Cell Signal from the Logical Dual Leaky Bucket Unit then it will read a new cell from said buffer-in unit that overwrites the old cell.

8. Method as claimed in any of the preceding claims, c h a r a c t e r i z e d i n that the incrementing of the PCR and the SCR of each connection is checked at a specific time interval (m), said checking including whether there is an ATM-cell waiting to be processed, and that if no cell is waiting the bucket state will be decremented.

9. Method as claimed in any of the preceding claims,

characterized in that if a new ATM-cell has arrived, then the real value of the PCR (Peak Cell Rate) bucket is calculated, whereafter said real value is placed in the associated CT (Counter Table), the process thereafter checking whether the real value thereof is greater than the maximum allowed PCR bucket value (T^{PCR}).

10. Method as claimed in claim 9, characterized in that if the real PCR bucket value is greater than a threshold value then a Not Send Cell signal is sent to said One Cell buffer which initiates the process to go to decrement bucket state.

11. Method as claimed in claim 9 or 10, characterized in that if the real PCR bucket value is equal or lower than said threshold value then the virtual value of said PCR bucket (L^{PCR}) will be incremented by an appropriate increment factor (I^{PCR}), whereafter the process will calculate the real value of said SCR bucket which value is placed in the associated CT (Counter Table) as a real value (F^{SCR}) for said connection.

12. Method as claimed in any of the claims 9-11, characterized in that the real value (F^{SCR}) of the PCR bucket for a specific connection is checked against the value of the threshold value (T^{SCR}) of said PCR bucket for said connection, and if said real value is greater than said threshold value there will be sent a Not Send Cell signal to said One Cell buffer.

13. Method as claimed in claim 12, characterized in that if the real value of said SCR bucket is equal or lower than its threshold value, then the virtual value (L^{SCR}) of said SCR bucket is calculated and a Send Cell signal is sent to said One

Cell buffer, whereafter the process goes to the decrement bucket state.

14. Method as claimed in any of the preceding claims, characterized in that the decrementing of said buckets takes place by firstly incrementing said time counter (m) for thereafter calculating the virtual value of said PCR and SCR bucket, respectively, for said actual connection number (m), after which calculation the process goes to an idle state.

15. Method as claimed in claim 14, characterized in that the virtual value of any PCR bucket for any connection (n) is decremented by D*M every M'th cell.

16. Method as claimed in any of the preceding claims, characterized in that there is used only a single time counter for all the connections involved.

17. Method as claimed in any of the preceding claims, characterized in that the increment value of a second bucket is varied according to appropriate criteria, and more specifically by setting the increment value to zero, possibly for using said method as a single leaky bucket.

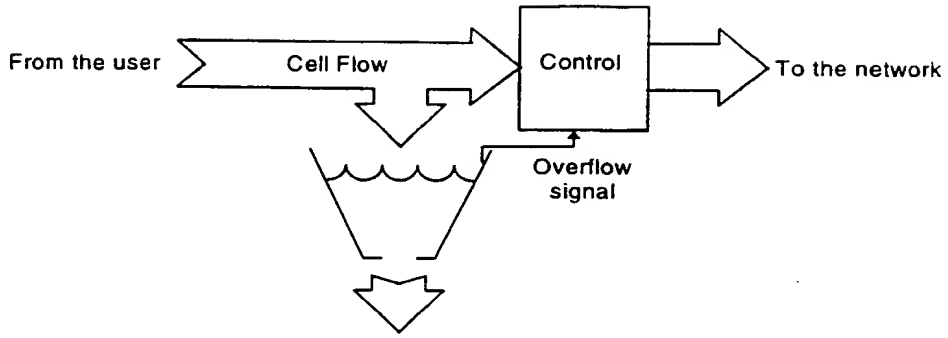

Figure 1 **A single Leaky Bucket. The bucket is filled according to the bit rate of the traffic sent by the user. It is emptied at fixed time intervals. The size of the bucket is dependent on i.e. the PCR and CDV.**

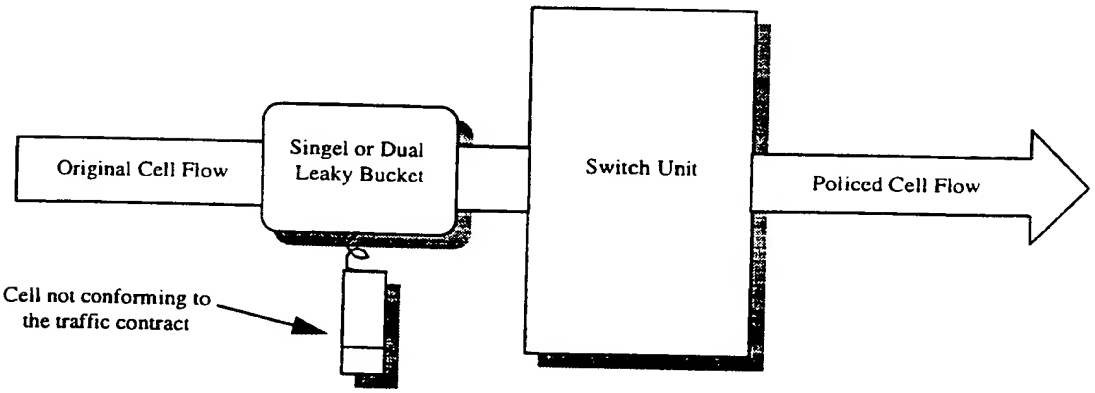

Figure 2 **The leaky bucket (single or dual) is placed in front of the switching unit.**

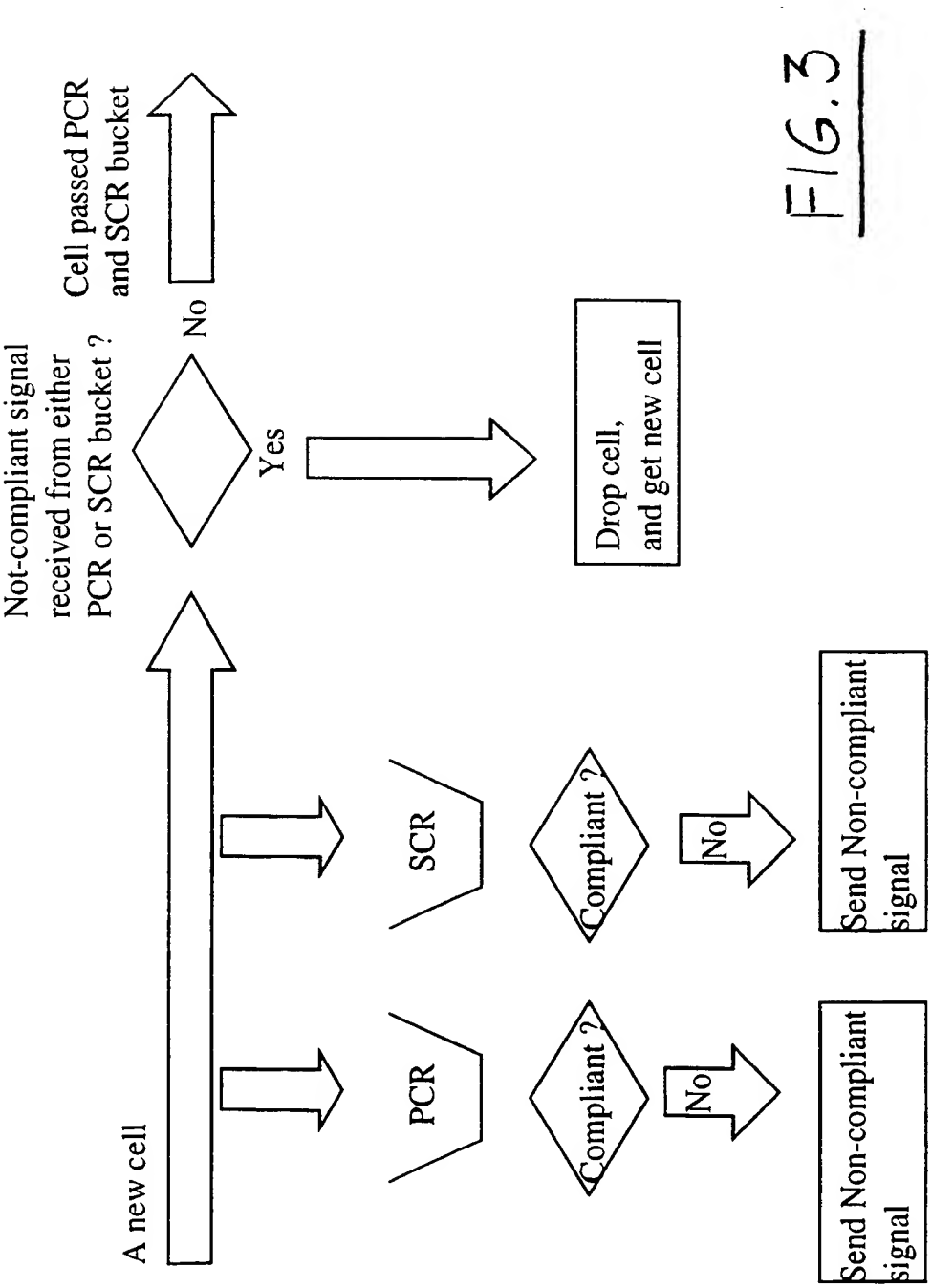
A new cell
PCR
SCR
Compliant ?
No
Send Non-compliant signal
Compliant ?
No
Send Non-compliant signal
Not-compliant signal received from either PCR or SCR bucket ?
Yes
Drop cell, and get new cell
No
Cell passed PCR and SCR bucket

FIG. 3

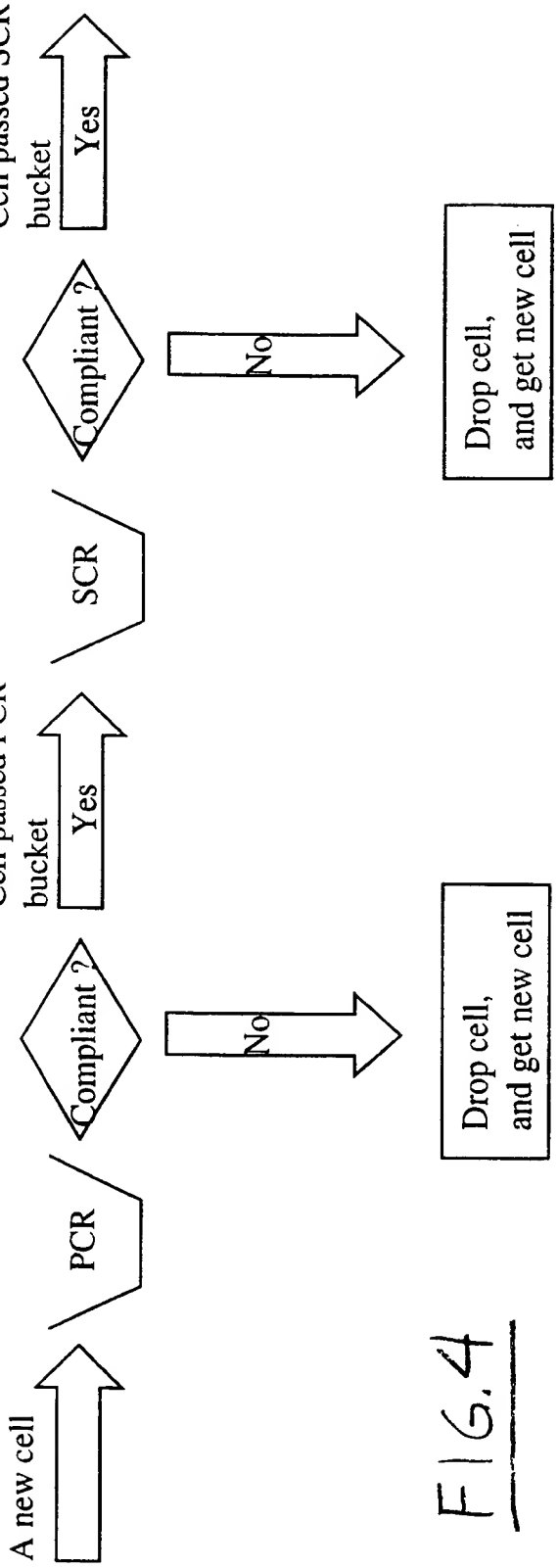
A new cell
PCR
Compliant ?
No
Drop cell, and get new cell
Cell passed PCR bucket
Yes
SCR
Compliant ?
No
Drop cell, and get new cell
Cell passed SCR bucket
Yes

FIG. 4

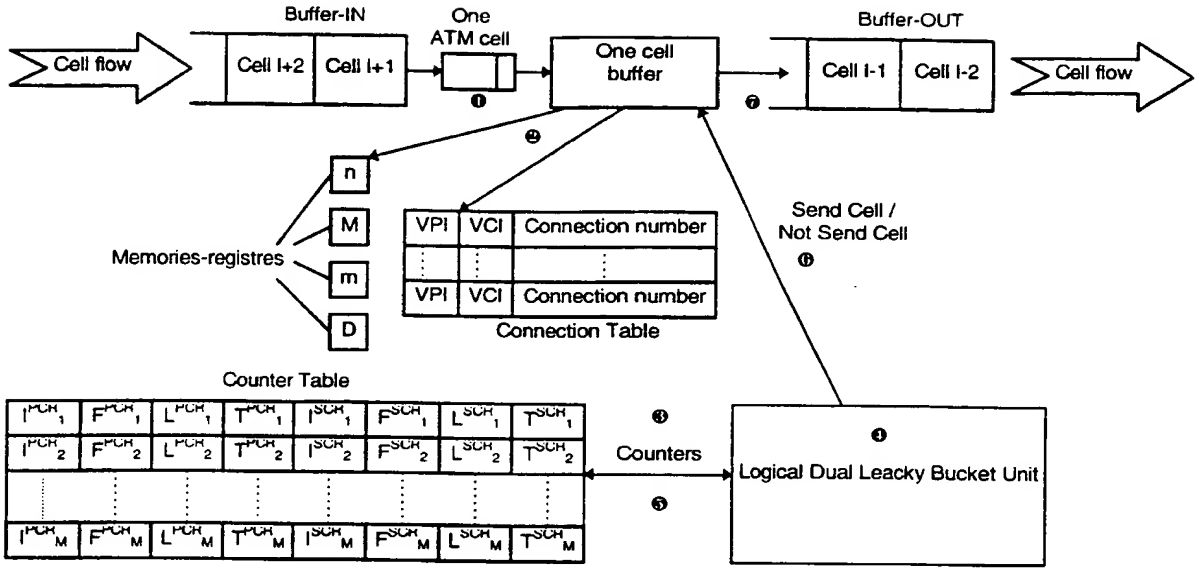

Figure 5 **A Schematically shown device for carrying out the invention. This figure is the inside of a Dual Leaky Bucket Unit shown in figure 2.**

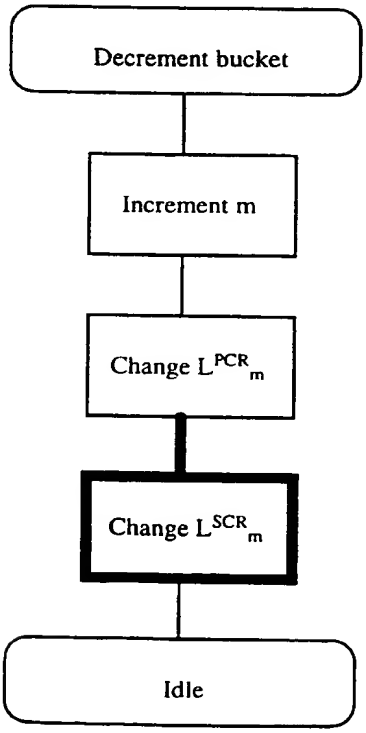

Figure 7 **State diagram showing the actions taken in this invention to decrement the PCR and SCR bucket.**

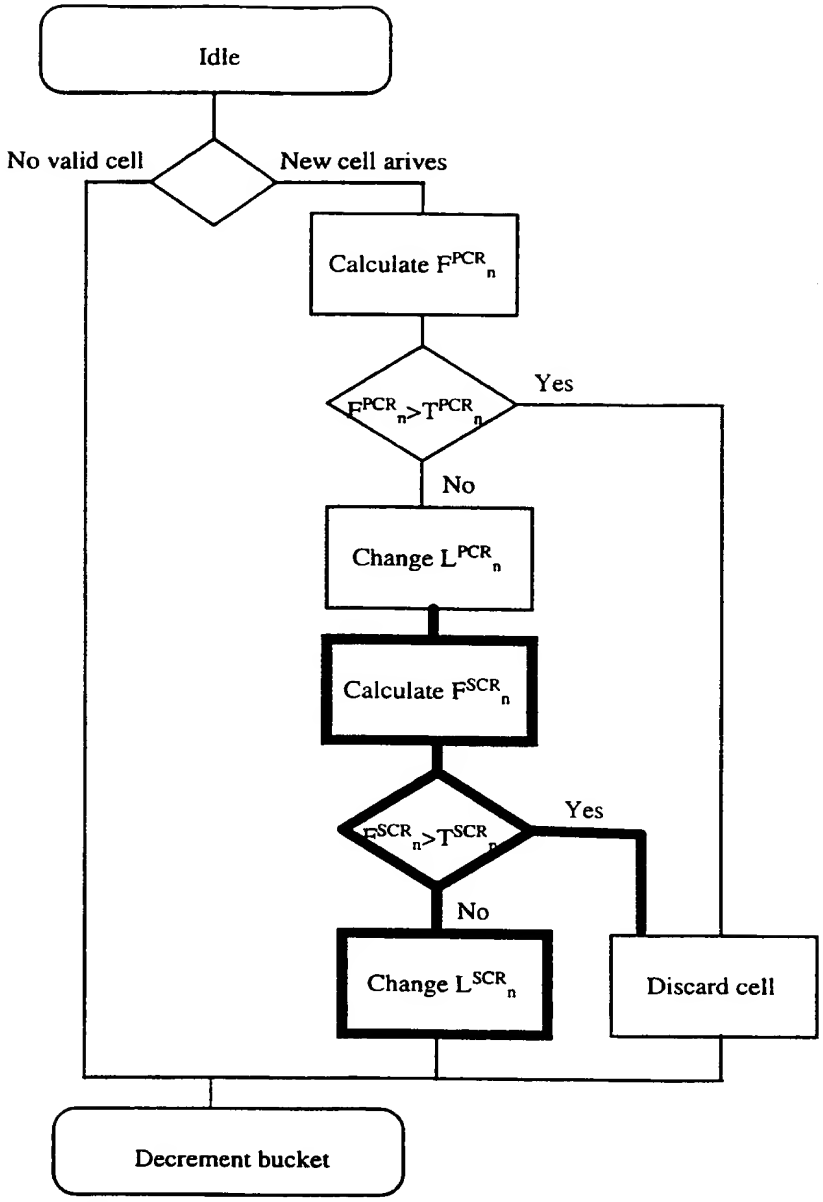

Figure 6 **State diagram showing the actions taken in this invention to increment the SCR and PCR buckets.**